The Pharma Innovation Journal 2023; 12(12): 4045-4047

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(12): 4045-4047

www.thepharmajournal.com
Received: 28-10-2023
Accepted: 30-11-2023

Manoj Kumar Chandraker
Department of Entomology
Pt. Shiv Kumar Shastri College of Agriculture and Research Station, Rajnandgaon, Chhattisgarh, India

Jayalaxmi Ganguli
Department of Entomology,
Pt. Shiv Kumar Shastri College of Agriculture and Research Station, Rajnandgaon, Chhattisgarh, India

Bhagwat Saran Asati
Department of Vegetable Science
Rani Avanti Bai Lodhi College of Agriculture and Research Station, Chhuikhadan, Chhattisgarh, India

Corresponding Author:
Manoj Kumar Chandraker
Department of Entomology
Pt. Shiv Kumar Shastri College of Agriculture and Research Station, Rajnandgaon, Chhattisgarh, India

Evaluating the efficacy of *Bracon hebetor* as a biocontrol agent for managing diamondback moth (*Plutella xylostella*) larvae on cabbage crop

Manoj Kumar Chandraker, Jayalaxmi Ganguli and Bhagwat Saran Asati

Abstract
In-vivo management of diamondback moth (DBM) larvae on cabbage crop by *Bracon hebetor* through Bracocards was evaluated in the research field of Pt. KLS College of Horticulture and Research Station, Rajnandgaon during 2016-17 and 2017-18. The release of cocoons of *Bracon hebetor* @ 8500 cocoons ha^{-1} (85 Bracocards) at 7, 12, 15 and 20 DAR was recorded as the most effective management practice with minimum larval population of 3.20, 2.43, 1.40 and 1.13 larvae $plant^{-1}$ while maximum larval population were recorded under control with 5.75, 5.68, 5.88 and 5.78 larvae $plant^{-1}$, respectively. Bio-control agents along with using different package of practices like timely sowing, use of tolerant varieties, intercropping and botanicals can be used to reduce the population pressure and minimize the pesticide application for an eco-friendly management of diamondback moth menace.

Keywords: DBM, bioagents, *Bracon* and cabbage

Introduction
Cabbage (*Brassica oleracea* var. *capitata*) is an important vegetable crop of cruciferous family (Brassicaceae), widely grown in the country. It is used as salad, boiled vegetable and dehydrated vegetable as well as in cooked curries and pickles. The cabbage crop is attacked by a number of insect pests. Diamondback moth (DBM) (*Plutella xylostella* L) is one of the most destructive insect pests and is the major limiting factor for successful cultivation of cruciferous crops resulting in loss of quality and production (Patil *et al.*, 1999) [12]. Diamondback moth has national importance on cabbage as it causes 50-80% annual loss in the marketable yield (Devjani and Singh, 1998) [5]. Hence, farmers are compelled to use chemical insecticides in order to cultivate lucratively, as traditional and cultural practices alone can not give satisfactory control over the pest menace. High doses and repetition of the same chemical in continue manner also promote insect resistance and as well as killing beneficial insects i.e. particularly bees as pollinators and natural enemies like predators and parasitoids (Pedigo and Rice, 2009) [13]. This has necessitated the use of botanicals and microbial agents and biocontrol of agents to sustain the management of DBM.

In the era of modern farming, large quantum of various insecticides are being used, due to which the population of natural enemies is going down day by day. For managing these ill effects, inundation and inoculation of bio-agents are required. Marsh (1917) [10] studied the effect of parasitoids against the naturally suppressed diamondback moth populations in cabbage. *Diadegma insulare* (Cresson), *Diadromus subtilicornis* (Gravenhorst) (Hymenoptera: Ichneumonidae), and *Microplitis plutellae* (Muesbeck) (Hymenoptera: Braconidae) are major parasitoids of the diamondback moth (Mahr *et al.* 1993) [9]. Parasitoid wasps as bio-agents are also responsible for minimizing pest populations in the field (Hentz *et al.*, 1998) [8]. Braconid wasps are important components of the biological approach against insect pests (Askew, 1971) [2]. Biological control is both economically and ecologically feasible for farmers to use, in addition to helping reduce the negative impacts of intensive agriculture on the environment. *Bracon hebetor* Say (Hymenoptera: Braconidae) is a cosmopolitan, gregarious, idiobiont ectoparasitoid that attacks the larval stage of several Lepidopterous species (Ghimire and Phillips, 2014) [6]. According to Akinkurolere *et al.* (2011) [1], the female of *B. hebetor* paralyze their hosts initially, which are typically last larval stage by stinging them, injective paralytic venom and ovipositing variable numbers of eggs on or near the surface of paralyzed host larvae. Keeping this in view, the present experiment was conducted on management of diamondback moth in cabbage by using *Bracon hebetor* in the form of cocoons as Bracocards

at Rajnandgaon district of Chhattisgarh.

Materials and Methods

In-vivo management of diamondback moth larvae on cabbage crop through *Bracon hebetor* was carried out during the year 2016-17 and 2017-18 at Rajnandgaon district of Chhattisgarh with six treatments and four replications in randomized block design from December to March. Five plants from each treatment were selected and covered with a muslin cloth (2 x 2 meter). *B. hebetor* @ 2000 cocoons ha^{-1} (20 Bracocards) as released for T_1 treatment. Similarly, *B. hebetor* @ 3500 (35 Bracocards), 4500 (45 Bracocards), 6500 (65 Bracocards) and 8500 cocoons ha^{-1} (85 Bracocards) were released on these protected plants for T_2, T_3, T_4 and T_5, respectively. Each Bracocard was prepared having 100 cocoons of *B. hebetor* stuck on it. Before the release of cocoons, the larval population of DBM was recorded and the post-release observations were recorded after 2th, 7th, 12th, 15th and 20th days after release. The treatments were applied when the population of DBM appeared. The protocols were obtained from the AICRP Bio-control laboratory of the Department of Entomology, College of Agriculture, Raipur, Chhattisgarh.

Results and Discussion

The population of DBM larvae plant^{-1} of cabbage as influenced by the release of different quantity of cocoons of *B. hebetor* @ 2000, 3500, 4500, 6500 and 8500 cocoons ha^{-1} was recorded in the experimental field at pre-treatment and post-treatment of 2, 7, 12, 15 and 20 DAR and data are presented Table 1 for the year 2016-17,2017-18 and pooled data. On the basis of pooled mean (2016-17 and 2017-18), the population of DBM larvae plant^{-1} recorded at second day after release of *B. hebetor* was found non-significant due to different treatments, however the population of DBM larvae plant^{-1} under different quantities of releases of cocoon of *B. hebetor* ranged from 4.88 to 5.20 larvae plant^{-1}. As regards to population of DBM larvae plant^{-1} recorded at 7, 12, 15 and 20 DAR, it was significantly affected by release of different quantities of cocoon of *B. hebetor*. The results revealed that release of cocoons of *B. hebetor* @ 8500 cocoons ha^{-1} was recorded as the most effective with minimum larval population 3.20, 2.43, 1.40 and 1.13 larvae plant^{-1} followed by release of cocoons of *B. hebetor* @ 6500 (4.48, 3.75, 2.30, 1.85 larvae plant^{-1}), 4500 (4.75, 4.13, 3.68, 3.48 larvae plant^{-1}), 3500 (4.70, 4.50, 4.13, 4.08 larvae plant^{-1}), 2000 (5.03, 4.93, 4.63, 4.50 larvae plant^{-1}) cocoons ha^{-1} and control (5.75, 5.68, 5.88, 5.78 larvae plant^{-1}), respectively. In the present investigation, the results revealed that release of cocoons of *B. hebetor* @ 8500 cocoons ha^{-1} recorded the best effective management practice with minimum population of DBM larvae plant^{-1} of cabbage. The release of a living organism as a biological control agent is self-perpetuating with the expectation that it will multiply in number and control the pest for an extended period, therefore, resulting in more number of individual of *Bracon* reduce the population of DBM larvae I i*n-vivo* condition on cabbage at different doses. A similar trend of data was obtained by Akinkurolere *et al.* (2011) [1] observed that the female of *B. hebetor* paralyzes their hosts initially, which are typically the last larval stage by stinging them, injective paralytic venom and ovipositing variable numbers of eggs on or near the surface of paralyzed host larvae. Ghimire and Phillips (2014) [6] also reported that *B. hebetor* is a cosmopolitan and gregarious, that control the larval stage of several lepidopterous species. The above findings are in agreement with the findings of Ghirtlahre (2017) [7] who tested the different treatments of *B. hebetor* for their efficacy for controlling of DBM on cabbage crop by releasing Bracocards. Among the treatments, T_5 Bracocard (20 cocoons plant^{-1}) was noticed as excellent and effective against the DBM larval population which recorded 9.73 larvae plant^{-1}. Chiu *et al*. (1974) [4] and Baoua *et al.* (2014) [3] also reported the reduction in the number of pest population of DBM and an increase in the natural rate of parasitism. Patra *et al.* (2013) [11], Ghimire and Phillips (2014) [6] also reported that the braconids as important parasitoids of diamondback moth, *Plutella xylostella* (L.) (Lepidoptera, Plutellidae) to reduce the pest population. According to Sarfraz *et al*. (2005) [14] various life stages of DBM are parasitized by braconids.

Table 1: Population of DBM larvae plant^{-1} of cabbage as influenced by release of different quantities of cocoon of *B. hebetor* during 2016-17 and 2017-18

S.N.	Treatment	Population of DBM larvae plant^{-1}																	
		Pre-treatment			2DAR			7DAR			12DAR			15 DAR			20 DAR		
		2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean
T_1	20 Bracocards ha^{-1}	4.60 (2.36)	5.70 (2.58)	5.15 (2.48)	4.55 (2.35)	5.65 (2.57)	5.10 (2.46)	4.45 (2.33)	5.60 (2.57)	5.03 (2.45)	4.35 (2.31)	5.50 (2.55)	4.93 (2.43)	3.95 (2.22)	5.30 (2.51)	4.63 (2.37)	3.80 (2.19)	5.20 (2.49)	4.50 (2.34)
T_2	35 Bracocards ha^{-1}	4.45 (2.33)	5.35 (2.51)	4.90 (2.43)	4.40 (2.28)	5.30 (2.51)	4.85 (2.41)	4.25 (2.29)	5.15 (2.48)	4.70 (2.39)	4.05 (2.24)	4.95 (2.44)	4.50 (2.34)	3.40 (2.09)	4.85 (2.41)	4.13 (2.26)	3.35 (2.08)	4.80 (2.40)	4.08 (2.25)
T_3	45 Bracocards ha^{-1}	4.35 (2.30)	6.25 (2.69)	5.30 (2.51)	4.30 (2.30)	6.10 (2.66)	5.20 (2.49)	4.10 (2.25)	5.40 (2.53)	4.75 (2.40)	3.65 (2.14)	4.60 (2.36)	4.13 (2.26)	3.10 (2.02)	4.25 (2.29)	3.68 (2.16)	3.05 (2.01)	3.90 (2.21)	3.48 (2.11)
T_4	65 Bracocards ha^{-1}	5.00 (2.45)	5.25 (2.50)	5.13 (2.47)	4.75 (2.39)	5.00 (2.43)	4.88 (2.42)	4.05 (2.24)	4.90 (2.44)	4.48 (2.34)	3.60 (2.14)	3.90 (2.21)	3.75 (2.18)	1.70 (1.64)	2.90 (1.97)	2.30 (1.82)	1.65 (1.62)	2.05 (1.74)	1.85 (1.69)
T_5	85 Bracocards ha^{-1}	4.95 (2.44)	6.15 (2.67)	5.55 (2.56)	4.80 (2.39)	5.15 (2.47)	4.98 (2.44)	2.55 (1.88)	3.85 (2.20)	3.20 (2.05)	2.10 (1.73)	2.75 (1.93)	2.43 (1.84)	1.15 (1.26)	1.65 (1.60)	1.40 (1.54)	1.10 (1.24)	1.15 (1.31)	1.13 (1.43)
T_6	Control	4.70 (2.38)	5.65 (2.57)	5.18 (2.48)	4.40 (2.31)	5.90 (2.61)	5.15 (2.48)	4.80 (2.41)	6.70 (2.76)	5.75 (2.59)	5.05 (2.46)	6.30 (2.70)	5.68 (2.58)	5.30 (2.50)	6.45 (2.73)	5.88 (2.62)	5.40 (2.52)	6.35 (2.71)	5.78 (2.60)
	SEm ±	0.10	0.07	0.07	0.14	0.10	0.08	0.07	0.08	0.06	0.13	0.08	0.08	0.10	0.08	0.06	0.09	0.12	0.08
	CD (P=0.05)	NS	NS	NS	NS	NS	NS	0.22	0.23	0.19	0.39	0.25	0.24	0.29	0.25	0.19	0.29	0.37	0.25

Note: Figures in parentheses are square root transformed values, DAR= date after release, Per Bracocards=100 cocoons of *B.hebetor*.

Conclusion

On the basis of the pooled mean (2016-17 and 2017-18), *in-vivo* management of diamondback moth larvae on cabbage crop through *B. hebetor*, the population of DBM larvae plant^{-1} recorded at 7, 12, 15 and 20 DAR, it was significantly affected by release of different quantities of cocoon of *B. hebetor*. The results revealed that release of cocoons of *B. hebetor* @ 8500 cocoons (85 Bracocards) ha^{-1} was recorded as the most effective treatment with minimum larval population 3.20, 2.43, 1.40 and 1.13 larvae plant^{-1} followed by release of cocoons of *B. hebetor* @ 6500 (65 Bracocards) ha^{-1} (4.48, 3.75, 2.30, 1.85 larvae plant^{-1}), 4500 (45 Bracocards) ha^{-1} (4.75, 4.13, 3.68, 3.48 larvae plant^{-1}), 3500(35 Bracocards) ha^{-1} (4.70, 4.50, 4.13, 4.08 larvae plant^{-1}), 2000(20 Bracocards) ha^{-1} (5.03, 4.93, 4.63, 4.50 larvae plant^{-1}) cocoons ha^{-1} and maximum larval population were recorded in control (5.75, 5.68, 5.88, 5.78 larvae plant^{-1}) at 7, 12, 15 and 20 DAR, respectively.

Acknowledgement

The author expresses his heartfelt gratitude to Dr. R. N. Ganguli, Professor, Department of Entomology for giving help and financial assistance during the successful conduction of the experiment.

References

1. Akinkurolere RO, Boyer S, Chen H, Zhang H. Parasitism and host-location preference in *Habrobracon hebetor* (Hymenoptera: Braconidae): Role of refuge, choice and host instar. Journal of Economic Entomology. 2011;102:610-615.
2. Askew RR. Parasitic insects. Heineman Educational Books, London; c1971. p. 316.
3. Baoua IB, Amadou L, Oumarou N, Payne W, Roberts JD, Stefanova K, *et al.* Estimating effect of augmentative biological control on grain yields from individual pearl millet heads. Journal of Applied Entomology. 2014;138(4):281-288.
4. Chiu SC, Chein CC, Chiu SS. Mass production and field liberation of larval parasite of DBM. Journal of Taiwan Agricultural Research. 1974;23:48-59.
5. Devjani P, Singh TK. Ecological succession of aphids and their natural enemies on cauliflower in Manipur. Journal of Aphidiol. 1998;12(1-2):45-5l.
6. Ghimire MN, Phillips TW. Oviposition and reproductive performance of *Habrobracon hebetor* (Hymenoptera: Braconidae) on six different pyralid host species. Entomological Society of America. 2014;107(4):809-817.
7. Ghirtlahre SK. Studies on the host variability and ovipositional behaviour of larval ectoparasitoid, *Bracon* spp. (Hymenoptera: Braconidae) at Raipur, Chhattisgarh. Ph.D. Thesis, Deptt. of Entomology, IGAU, Raipur. 2017, 95.
8. Hentz MG, Ellsworrth PC, Naranjo SE, Watson TF. Development, longevity and fecundity of *Chelonus* sp. of pink bollworm (Lepidoptera: Gelechiidae). Environ. Entomology. 1998;27(2):443-449.
9. Mahr SER, Mahr DL, Wyman JA. Biological control of insect pests of cabbage and other crucifers. Cooperative Extension publication, University of Wisconsin; c1993. p. 55.
10. Marsh HO. Life history of *Plutella maculipennis*, the diamondback moth. Journal of Agricultural Research. 1917;10:1-10.
11. Patra S, Dhote VW, Alam SKF, Das BC, Chatterjee ML, Samanta A. Population dynamics of major insect pests and their natural enemies on cabbage under new alluvial zone of West Bengal. The Journal of Plant Protection Sciences. 2013;5(1):42-49.
12. Patil BA, Shah PG, Raj MF, Patel BK, Patel JA, Talathi JG. Chlorpyriphos residues in/on cabbage and brinjal. Pest. Research Journal. 1999;11(2):195-195.
13. Pedigo LP, Rice M. Entomology and pest management. Sixth edition; c2009. p. 234.
14. Sarfraz M, Keddie AB, Dosdall LM. Biological control of the diamondback moth, *Plutella xylostella*: A review Bio-control Science and Technology. 2005;15(8):763-789.